UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 9, 2009

Mr. Rafael Flores
Senior Vice President and
Chief Nuclear Officer
Attention: Regulatory Affairs
Luminant Generation Company LLC
P.O. Box 1002
Glen Rose, TX 76043

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2 – TRANSMITTAL OF UNRESOLVED ISSUES REGARDING PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATORS (TAC NOS. ME1446 AND ME1447)

Dear Mr. Flores:

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated June 8, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091670154), as supplemented by letters dated August 20 and 27, and September 2 (two letters), 14, 17, and 28, 2009 (ADAMS Accession Nos. ML092370304, ML092520324, ML092530579, ML092660453, ML092650287, ML092670205, and ML092790184, respectively), Luminant Generation Company, LLC (the licensee), submitted a license amendment request to revise the technical specifications (TS) of Comanche Peak Steam Electric Station (CPSES), Units 1 and 2. The request proposed changes to the inspection scope and repair requirements of TS section 5.5.9.2, "Steam Generator (SG) Program," and to the reporting requirements of TS section 5.6.9, "Unit 1 Model D76 and Unit 2 Model D5 Steam Generator Tube Inspection Report." The proposed changes would have established permanent alternate repair criteria for portions of the SG tubes within the tubesheet.

On September 2, 2009, in a teleconference between the NRC staff and industry personnel including the licensee, the NRC staff stated that an issue relating to the treatment of tubesheet bore eccentricities had not been resolved to the NRC staff's satisfaction and that there was insufficient time to resolve this issue and evaluate the permanent amendment request for the fall 2009 refueling outages at CPSES, Unit 2. By letter dated September 14, 2009, the licensee revised its amendment request to be an interim change applicable to Unit 2 during Refueling Outage 11 and the subsequent operating cycle instead of the permanent change originally requested.

In its September 14, 2009, letter, the licensee requested that the NRC staff provide the specific questions concerning the tubesheet bore eccentricity issue which must be resolved to support a permanent alternate criteria amendment request.

Accordingly, enclosed are the specific questions that are currently identified and remain unresolved concerning the eccentricity issue. This information would be needed for the NRC staff to complete its review of any future permanent alternate repair criteria amendment request.

Sincerely,

Balwant K Singal

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

Enclosure:
As stated

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TRANSMITTAL OF UNRESOLVED ISSUES REGARDING

PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATORS

COMANCHE PEAK STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-445 AND 50-446

BACKGROUND

By letter dated June 8, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091670154), as supplemented by letters dated August 20 and 27, and September 2 (two letters), 14, 17, and 28, 2009 (ADAMS Accession Nos. ML092370304, ML092520324, ML092530579, ML092660453, ML092650287, ML092670205, and ML092790184), Luminant Generation Company, LLC (the licensee), submitted a license amendment request to revise the technical specifications (TS) of Comanche Peak Steam Electric Station (CPSES), Units 1 and 2. The request proposed changes to the inspection scope and repair requirements of TS section 5.5.9.2, "Steam Generator (SG) Program," and to the reporting requirements of TS section 5.6.9, "Unit 1 Model D76 and Unit 2 Model D5 Steam Generator Tube Inspection Report." The proposed changes would have established permanent alternate repair criteria for portions of the SG tubes within the tubesheet.

On September 2, 2009, in a teleconference between the U.S. Nuclear Regulatory Commission (NRC) staff and industry personnel including the licensee, the NRC staff stated that an issue relating to the treatment of tubesheet bore eccentricities had not been resolved to the staff's satisfaction and that there was insufficient time to resolve this issue and evaluate the permanent amendment request for the fall 2009 refueling outages at CPSES, Unit 2. By letter dated September 14, 2009, the licensee revised its amendment request to be an interim change applicable to CPSES, Unit 2 during Refueling Outage 11 and the subsequent operating cycle instead of the permanent change originally requested. The licensee requested that the staff provide the specific questions concerning the eccentricity issue which must be resolved to support a permanent amendment.

Below are the specific questions that are currently identified and remain unresolved concerning the tubesheet bore eccentricity issue. This information is needed in order for the NRC staff to complete its review of any future request for a permanent amendment.

UNRESOLVED QUESTIONS

1. Provide a complete description of the model used to develop the relationship between eccentricity and scale factor in Section 6.3 of Reference 1. This description should address, but not be limited to addressing, the following questions:

    a. Provide a complete description of Table RAI [request for additional information] 4-3 in Reference 2. Give complete details of the role of the "slice model" in the development of this table. Give complete details of the role of the 2-D lower SG shell axisymmetric model in the development of this table.

Enclosure

b. Confirm the relevancy of each of the input parameters listed at the top of the table. For example, if the table is entirely based on the "slice model" results, then the assumed shell and channel head temperatures do not seem to be relevant to the results in Table RAI 4-3.

c. Explain why there are two values listed for tube/tubesheet interaction values listed at the top of Table RAI 4-3. Explain the differences between the two values in detail. Explain why one of the values is negative.

d. Given that the final eccentricity values shown in Table RAI 4-3 were obtained from the slice model and that the only load considered in the analysis was a temperature loading of the tube and sleeve, explain how it is physically possible for the final eccentricity to be larger than the initial eccentricity. Might this result indicate that the slice model is not valid and, if not, why?

e. Why are the listed contact pressures in Table RAI 4-3 different from those in **[Table?]** RAI 4-2 for the same level of initial eccentricity? What method of analysis was used to calculate the contact pressures in Table RAI 4-3? What coefficient of thermal expansion (CTE) was assumed for the tubesheet when determining the final eccentricities and contact pressures in Table RAI 4-3? If greater than zero, why were consistent assumptions for tubesheet CTE not used for developing both Table RAI 4-2 and Table RAI 4-3 and why does the use of a non-zero value for CTE produce conservative values of scale factors in Table RAI 4-4?

f. Item 5 near the top of page 18 of Reference 2 states that the slice model provides the input for using the scale factor relationship (equation RAI 4-1). This differs from the NRC staff's understanding from Section 6.3 of Reference 1 that it is the eccentricities and delta (Δ) Ds from the 3-D finite element analyses (or the axisymmetric model in previous analyses) that are actually used as input to equation RAI 4-1. Please clarify this apparent discrepancy.

2. On page 9 of Reference 2, it is stated that the polynomial fit between initial eccentricity and scale factor (old eccentricity model) was appropriate for the conditions for which it was developed, but leads to physically impossible results when extrapolated significantly outside its "data basis" such as was the case for the steam line break (SLB) conditions for the Model D-5 SGs. This apparently refers to the fact that the old eccentricity model was based on the application of a temperature loading of 500 degrees Fahrenheit to the slice model whereas the tube and tubesheet temperatures during SLB for Model D5 SGs is substantially less than this value. The NRC staff has the following questions:

   a. The slice model used to develop Table RAI 4-2 considered a 500 degree F expansion of the tube and sleeve, but no temperature expansion of the tubesheet. The NRC staff notes that this is not prototypical for either model SG under any condition. What is the rationale for saying that the SLB temperatures for Model D5 SGs are outside the "data basis" for the old eccentricity model, but that the normal operating temperatures for the Model F and D5 SGs and SLB temperature for Model F SGs are consistent with the data basis? This question references Table RAI 4-2 only, since the NRC staff is unclear about what tubesheet temperature expansion was assumed in Table RAI 4-3 (see question 1.e above).

b. The data basis for the old eccentricity model does not include pressure loadings. What is the rationale for concluding that actual pressure conditions do not represent an extrapolation significantly outside the data basis?

c. The old eccentricity model considered a sleeve to be present, which is not the case for the plants in question. The assumed presence of a sleeve is tantamount to considering a tube which has twice the radial stiffness of an unsleeved tube. What is the rationale for concluding that use of the actual radial stiffness of sleeved tubes does not represent an extrapolation significantly outside the data basis?

d. The old eccentricity model, including the third order polynomial expression for scale factor, was developed for eccentricity values ranging to a maximum value as given in Table 6-20 of Reference 1. This value comes close to bounding the maximum eccentricities calculated by the 3-D finite element models for Model D5 SGs under normal operating and SLB conditions. However, this value is less than half of the calculated eccentricities from the 3-D finite element analysis for the Model F SGs. Whereas the maximum scale factor for Model D5 SGs for SLB just slightly exceeds the maximum value in the "data basis" (Table 6-20 in Reference 1), the maximum value of scale factor for the Model F SLB case is well beyond the "data basis." Why do such wide extrapolations from the data basis for Model F SGs lead to conservative results?

3. Reference 2 states at the top of page 19, "The results from the "slice" model cannot be linearly scaled to lower temperatures because the method of superposition has been shown during the development of the current H* analysis to not apply to the non-linear combination of materials and loading in the lower SG complex." Is the old eccentricity model entirely based on the slice model and not the axisymmetric model of the lower SG complex? Assuming this understanding is correct, explain why the results of the slice model are not scalable to lower temperatures.

4. Table RAI 4-1 in Reference 2 is accompanied by the "original Table RAI 4-4." Explain the differences between these two tables. For example, the original Table RAI 4-4 shows an average eccentricity for Model D5 SGs for normal operating conditions, which appears different from the average eccentricity data in Table RAI 4-1.

5. Regarding Table RAI 4-5 of Reference 2:

   a. What are the temperature inputs (Step 5) for each case?

   b. What are the displacements of the horizontal and vertical edges of the cell model after each of the Steps 4 through 9?

c. Are the E-bar displacements added to the displacements existing after Step 5, or do the applied E-bar displacements replace the displacements existing after Step 5? Why are the applied E-bar displacements not over-restraining the model? The NRC staff notes that the applied E-bar displacements do not allow for further displacement of the upper and lower edges during Steps 7 through 9, tending to maximize the contact stresses. Would it not be more realistic to apply force boundary conditions (rather than displacement boundary conditions) to the horizontal edges of the cell models such as to achieve the desired eccentricity?

d. What are the displacement boundary conditions (applied during Step 6) that are applied to the sides of the square cell? Free to displace? Zero displacement?

e. Provide an expanded version of Table RAI 4-5 which shows the average, maximum, and minimum contact pressures as a function of E-bar for Steps 5 through 9 as defined in Figure RAI 4-2.

f. Contact pressure seems to reach essentially zero for eccentricity values that are only one-fourth of the maximum values calculated by the 3-D finite element model, as shown in Table RAI 4-1, for Model F SGs and one-third for Model D5 SGs. Why does this not imply a loss of contact between the tube and tubesheet at locations where the 3-D finite element model is predicting relatively high eccentricities? A related question pertains to item 2 on page 21 of Reference 2 which states that eccentricities from the unit cell model are "generally comparable" to those from the 3-D finite element analysis (FEA) model. Explain the apparent discrepancy between the words "generally comparable" and how the unit cell eccentricities in Table RAI 4-5 actually compare to 3-D FEA eccentricities. Explain how the unit cell model adequately addresses the actual range of eccentricities from the 3-D FEA model.

6. Provide information as needed to reconcile Table RAI 4-6 with Table RAI 4-1 in Reference 2. For example, the eccentricities in line 3 of Table RAI 4-6 for Model D5 do not match eccentricities in Table RAI 4-1. The NRC staff has the same question about the average ΔDs in the two tables, although in this case the differences are minor. Also, explain why the average contact pressures in line 6 of Table RAI 4-6 do not match those in Table 6-25 of Reference 1.

7. The bullet at the bottom of page 19 of Reference 2 states, "To address if tube to tubesheet contact continues for all assumed tubesheet displacements, the appropriate reference condition is the initialized condition (after Step 4) of the model that simulates a tube expanded in the tubesheet bore." Please clarify this sentence. Is it based on a premise that the residual contact pressures (introduced during Steps 1 through 4) are to be ignored? If not, explain why the statement is true. The NRC staff notes that the test of whether tube-to-tubesheet contact is actually maintained is whether positive contact pressure is maintained all around the circumference of the tube.

8. The bullet at the top of page 20 states, "To compare the results of the unit cell model with the 3D FEA model, the appropriate reference condition of the unit cell model is the initial model (Step 0) without the tube expansion simulated and thermal loads must be

included." Please clarify this sentence. Does this statement refer to the bore diameter displacements and eccentricities, or does it refer to some other parameter? Do the bore displacements from Step 1 through at least Step 5 (if not Step 9, depending on the response to question 5.b above) of the unit cell model reflect the tube expansion process in Steps 1 through 4 and, if not, why? Is it not primarily Steps 5 and 6 that are intended to replicate the FEA and, if not, why? If yes, then why is Step 4 not the appropriate reference condition for comparing the displacements from Step 6 for purposes of comparison with the 3-D FEA displacements?

9. Figures RAI 4-5 for Model F and RAI 4-6 for Model D5 SGs show the relationship between the applied E-bar displacement and the resulting eccentricity of the tubesheet bore. The slope of the relationship changes sharply above the third data point and actually becomes negative for normal operating conditions (NOP). The discussion of these figures on page 20 needs to be clarified or expanded to allow the NRC staff to understand the reason for these trends. For example, for the case of NOP, explain how an increase in the applied E-bar displacement can lead to a decrease in tubesheet bore eccentricity when all other variables, including temperature and pressure are held constant. This explanation should include the unit cell displacement diagrams showing both the E-bar displacements and the bore displacements for incrementally different values of E-bar.

10. Item 1 on page 21 of Reference 2 states, "The ΔDs from the 3D FEA model are significantly less than the corresponding ΔDs from the unit cell model from the unloaded to fully loaded condition ...". Explain how this supports the conclusion in item 1 that the unit cell model displacement and contact pressure results conservatively represent the reference 3-D FEA results. The NRC staff notes that the ΔDs from the unit cell model include the effects of pressure acting on the inside surface of the tube, whereas the 3-D FEA results do not. How do the incremental bore ΔDs from Steps 5 and 6 of the unit cell model compare with the results from the 3-D FEA analysis? Does this comparison support the conclusion in item 1?

11. The words "bore eccentricities" in the first line of the last paragraph on page 28 of Reference 2 should read "E-bar displacements," correct? If not, why?

12. From the bottom of page 28 to page 33 of Reference 2, the text appears to discuss a new eccentricity analysis. The NRC staff has the following questions concerning this analysis.

    a. What are the specific objectives of the analysis?

    b. Specifically, how is the analysis different from the analyses performed in the Model D5 White Paper (Reference 3)?

    c. Describe the analysis in detail.

    d. Provide a table of results similar to RAI 4-5 in Reference 2, but expanded to include the information requested in question 5.e above.

e. The assumed ΔT at the top of page 29 for the case of Model D5 SLB does not appear be consistent with what is assumed in the reference analysis in Reference 1 or with what is assumed in Reference 3. Explain this apparent discrepancy.

f. Why does the analysis discussed in the first paragraph on page 29 consider a location 2 inches below the top of the tubesheet rather than the top of the tubesheet where the eccentricities are generally higher? Why is consideration of the 2-inch location conservative from the standpoint of evaluating the eccentricity effect?

g. The term "Figure RAI 4-10" is used for two different figures on pages 31 and 32. This RAI will refer to the figure on page 32 as Figure RAI 4-10a for clarity. The second paragraph on page 29 refers to Figure RAI 4-8 which appears to be an incorrect figure number. Is Figure RAI 4-9 the correct figure?

h. Regarding Figure RAI 4-9, it is unclear what the horizontal axis represents since the terms "relative tubesheet displacement, e (in)" is ambiguous. Is it eccentricity, Dmax – Dmin, or Ebar?

i. Is it correct that in the legend for Figure RAI 4-9, "H* Results – Old Fit" refers to the old eccentricity model discussed in Section 6.3 of Reference 1, "H* Results – New Fit" refers to the new eccentricity model discussed in Reference 3, and "Model D5 FEA Trend" refers to the most recent model discussed on pages 28 to 34 of Reference 2? If incorrect, provide the correct information.

j. The third paragraph on page 19 states that Figure RAI 4-9 shows contact pressure ratio as a function of E-bar. Should "RAI 4-9" read "RAI 4-10?"

k. Explain in detail how each of the curves in Figures RAI 4-9 and RAI 4-10 were determined.

13. Provide an updated version of "Table RAI 4-7 (Reference 2)" showing the contact pressure reduction and final contact pressure as a function of eccentricity based on the "old eccentricity model" (Reference 1, Section 6.3), "new eccentricity model" (Reference 3), and the latest eccentricity model (Reference 2). The table should include both Model F and Model D5 SGs for normal operating and SLB conditions. The eccentricity cases should be those that can be cross-referenced with the updated versions of RAI 4-5 of Reference 2 requested in questions 5.e and 12.d above.

14. The calculated H* distances in Reference 1 took no credit for residual contact pressure due to the hydraulic tube expansion process. Calculated H* distances for the case where credit is taken for the residual contact pressure was provided in Reference 4. Is it necessary to take credit for residual contact pressure to support a conclusion that the tubes remain in contact with the tubesheet for the full circumference of the tubes at all locations for normal operating and accident conditions? If so, provide the rationale that there is sufficient residual contact pressure to support such a conclusion.

REFERENCES

1. R. Flores, Luminant Generation Company LLC, letter to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, License Amendment Request 09-007, Model D5 Steam Generator Alternate Repair Criteria," dated June 8, 2009 (ADAMS Accession No. ML091670154). This letter also transmitted Westinghouse Electric Company LLC report, WCAP-17072-P (Proprietary) and WCAP-17072-NP (Non-Proprietary), Rev. 0, "H*: Alternate Repair Criteria for the Tubesheet Expansion Region in Steam Generators with Hydraulically Expanded Tubes (Model D5)," dated May 2009 (ADAMS Accession No. ML091670172 (Non-Proprietary)).

2. R. Flores, Luminant Generation Company LLC, letter to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, Response to Request for Additional Information Regarding License Amendment Request 09-007, Model D5 Steam Generator Alternate Repair Criteria," dated August 27, 2009 (ADAMS Accession No. ML092520324). This letter also transmitted Westinghouse Electric Company LLC letter, LTR-SGMP-09-109-P (Proprietary) and LTR-SGMP-09-109-NP (Non-Proprietary) "Response to NRC Request for Additional Information on H*; RAI #4; Model F and D5 Steam Generators," dated August 25, 2009.

3. Westinghouse Report LTR-SGMP-09-66-P, LTR-SGMP-66-NP, "White Paper: Low Temperature Seam Line Break Contact Pressure and Local Tube Bore Deformation Analysis for H*," May 13, 2009 (ADAMS Accession Nos. ML092610441 (Proprietary) and ML092610440 (Non-Proprietary)).

4. R. Flores, Luminant Generation Company LLC, letter to U.S. Nuclear Regulatory Commission, "Comanche Peak Steam Electric Station, Docket Nos. 50-445 and 50-446, Response to Request for Additional Information Regarding License Amendment Request 09-007, Model D5 Steam Generator Alternate Repair Criteria," dated August 20, 2009 (ADAMS Accession No. ML092370304). This letter also transmitted Westinghouse Electric Company LLC letter, LTR-SGMP-09-100-P (Proprietary) and LTR-SGMP-09-100-NP (Non-Proprietary), "Response to NRC Request for Additional Information on H*; Model F and D5 Steam Generators," dated August 12, 2009.

Accordingly, enclosed are the specific questions that are currently identified and remain unresolved concerning the eccentricity issue. This information would be needed for the NRC staff to complete its review of any future permanent alternate repair criteria amendment request.

Sincerely,

/RA/

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-445 and 50-446

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ADAMS Accession No: ML093360490 ***Memo dated 11/3/09**

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